Intelligent Information Processing for Enhanced Safety in the NAS, Phase II

Completed Technology Project (2017 - 2020)

Project Introduction

Our Phase I work focused on how improved information flow between actors in a flight deck environment can improve safety performance. An operational prototype was developed demonstrating how the Intelligent Information Processing System (IIPS) will operate in actual accidents/incidents. For Phase II, we propose the following operating environment extensions from the flight deck environment: NextGen scenarios emphasizing interactions with air traffic controllers operating in fast paced, increased volume of manned and autonomous traffic; UAV operations emphasizing introduction of UAVs into the NAS, transition to autonomy and fully autonomous operations; and IIPS in flight training environments both simulated and airborne. We also propose an extension to the manner in which conditions were developed in Phase I. Conditions were developed using post analysis of accidents and incidents. The error chain of events was identified, information necessary to prevent the event was identified, and finally, a condition developed that detected the circumstances for a possible safety failure so that a notification could be transmitted to the actor who would then take the appropriate action to break the error chain. This paradigm of condition development can be characterized as reactive. With the NAS moving into a state of flux with the integration of UAVs and general increased traffic volume, reactive safety may not be acceptable. In order to continue the steadily improving safety record of aviation, a more proactive approach must be considered. We propose the use of a classical rule-based expert system and other artificial intelligence approaches that can make inferences of possible unsafe conditions using a temporal knowledge base populated by propositional statements generated by IIPS information sources.

Anticipated Benefits

Integrating the proposed system with the ATOS/SMART-NAS development effort:It is possible to integrate the IIPS with NASA's Airspace and Traffic Operations Simulation (ATOS) that is currently being integrated into the Shadow Mode Assessment Using Realistic Technologies for the National Airspace System (SMART-NAS) test bed. In this integration effort, large number of ASTORs being run on the Amazon cloud cannot be monitored for correct behavior during runs and can only be verified by post processing. The IIPS can be developed to monitor ASTORs for reasonable flight performance and generate alerts along with additional context when simulated aircraft begin to deviate. Integrating the IIPS with the ATOS may allow subsequent integration with additional simulation platforms as they are integrate into the SMART-NAS test bed. This may allow for seamless systems-level development on a National Airspace System level. It is also possible to use IIPS to support the transition to autonomy as IIPS develops its valued information at the right time (VIRT) concepts. As autonomous UAV systems continue to develop, there will be situations where the autonomy will fail. It may be possible to have a human operator step in and perform a better recovery of the autonomous

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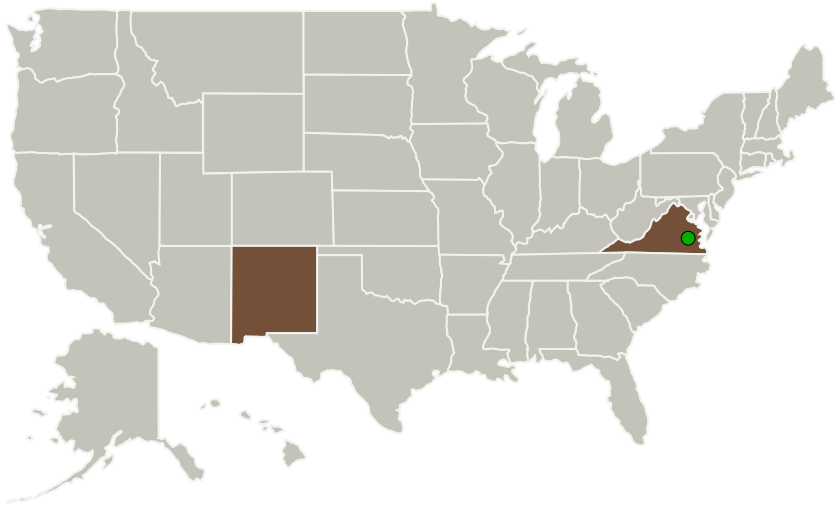
vehicle. The IIPS VIRT functionality will optimize the time for a human operator to develop a complete and accurate situational assessment and perform the appropriate recovery actions.The IIPS technology contributes to several FAA near-term goals. In order to be of practical use, IIPS must implement conditions that have been identified either as safety enhancements per Commercial Aviation Safety Team Safety Enhancements (CAST SEs), or as accident causes per the Joint Safety Analysis Team Controlled Flight Into Terrain (JSAT CFIT) and Joint Safety Implementation Team Loss of Control (JSIT LOC) documents. The IIPS may be in a special situation where it can implement specific recommendations by the documents not done so to date by the aviation community at large. Notification terminal information and presentation must also be consistent with recommendations and guidelines defined by the same documents. It should be noted that these documents refer to other documents such as the Flight Operational Quality Assurance (FOQA) or that there may be additional documents such as Advisory Circular 25.1322-1 Flightcrew Alerting that must be considered while developing conditions and notifications. A critical consideration for the IIPS is that it may implement a redundant check or may monitor other alerts or notifications so that an adaptive and enhanced alert or notification may be issued when the initial and primary alert fails to initiate remedial actions by the intended audience.

Primary U.S. Work Locations and Key Partners



Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Metis Technology Solutions, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:

Kyle K Ellis
Keith L Woodman

Principal Investigator:

Richard Jessop

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
Metis Technology Solutions, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Albuquerque, New Mexico
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
New Mexico	Virginia

Project Transitions

April 2017: Project Start

September 2020: Closed out

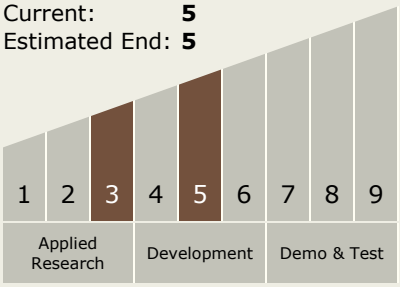
Closeout Documentation:
- Final Summary Chart*(https://techport.nasa.gov/file/140974)*

September 2020: Closed out

Closeout Documentation:
- Final Summary Chart PDF*(https://techport.nasa.gov/file/140975)*

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System

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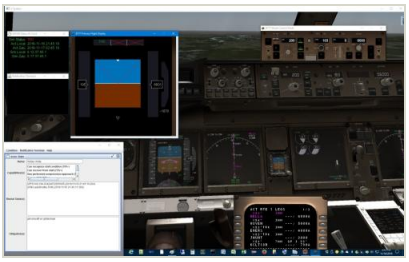
Images



Briefing Chart Image
Intelligent Information Processing for Enhanced Safety in the NAS, Phase II Briefing Chart Image *(https://techport.nasa.gov/image/127058)*

Final Summary Chart Image
Intelligent Information Processing for Enhanced Safety in the NAS, Phase II *(https://techport.nasa.gov/image/130670)*